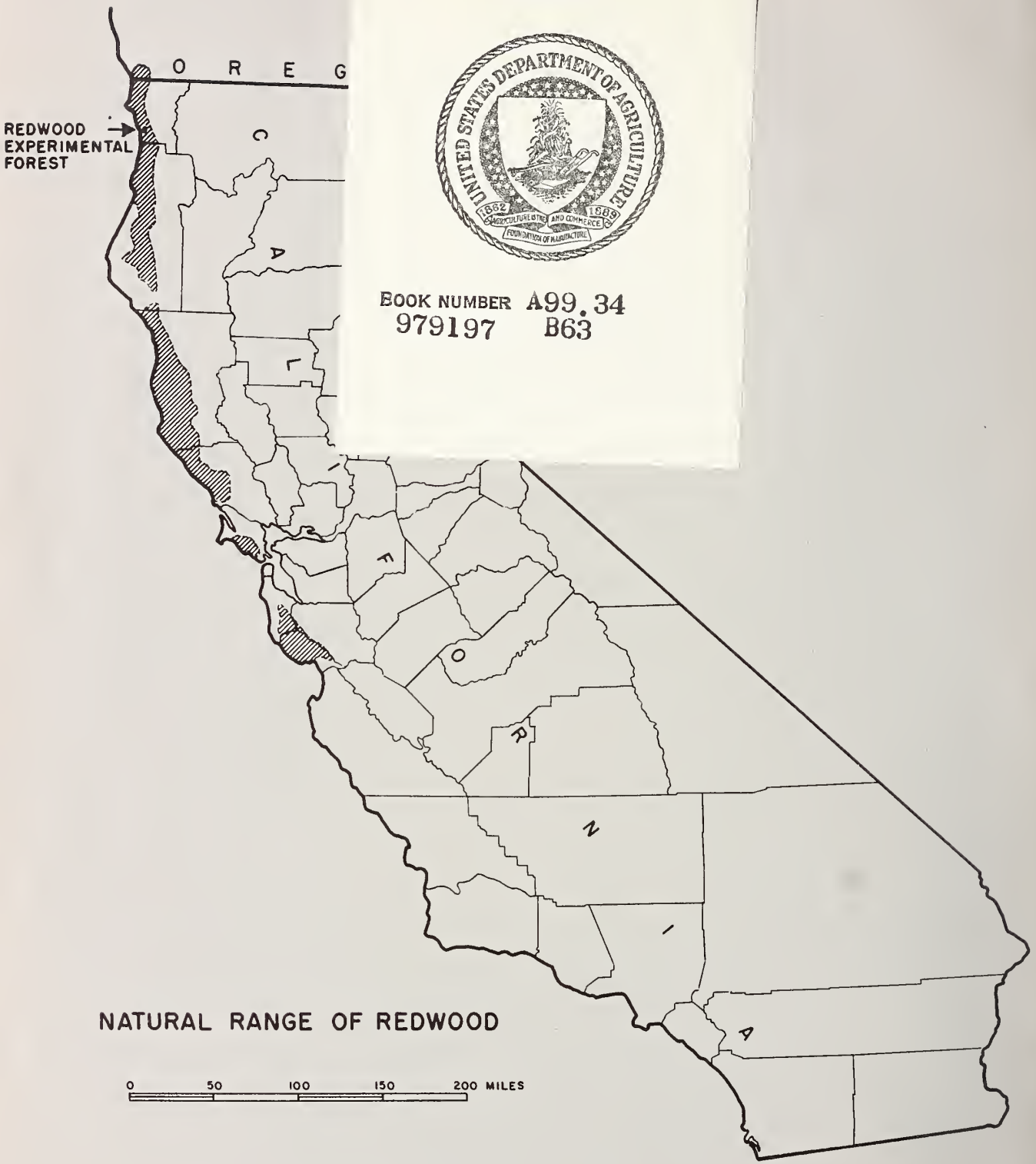
PACIFIC SOUTHWEST
FOREST AND RANGE
EXPERIMENT STATION
Berkeley - California

Research at the Redwood Experimental Forest

IN COOPERATION WITH THE SIMPSON REDWOOD COMPANY

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE



NATURAL RANGE OF REDWOOD

Redwood Experimental Forest

By Kenneth N. Boe

The research program on this experimental forest is a cooperative venture of the Simpson Redwood Company and the Pacific Southwest Forest and Range Experiment Station. The purpose is to conduct experiments and demonstrations which will benefit all forest land owners of northwestern California by obtaining accurate information on methods of management, silviculture, logging techniques, utilization, and watershed management adapted to sustained yield forestry in the redwood and redwood—Douglas-fir types.

The cover type is typical old-growth redwood characteristic of the northern part of its range. Douglas-fir is the principal associate, and at higher elevations it sometimes is the predominant species. Other conifer species found are western hemlock, Sitka spruce, Port-Orford-cedar, and western redcedar.

Location: Northwestern California, Del Norte County, 4 miles north of Klamath, 17 miles south of Crescent City near Highway 101.

Climate: Mild and humid. Rainfall at Klamath has averaged 86.0 inches annually based on a 16-year record. The July-August-September average is 2.58 inches but fog occurs frequently during this dry period. The frost-free period averages 8 months.

Soil: Deep clay loam, moderately to strongly acid.

Site quality: Medium to good. Dominant trees on good redwood sites are 100 to 150 feet tall at 50 years of age and 165 to 220 feet at 100 years.

Topography: Slopes moderate to very steep. Numerous V-shaped water courses. Slightly rounded ridges.

Elevation: 50 to 1,600 feet.

Area: The study area contains 2,105 acres—the entire High Prairie Creek watershed; 935 acres are national-forest land; 1,170 acres are owned by Simpson Redwood Company.

The Research Project

Old-growth redwood experiments now underway will show which reproduction cutting method--clear cutting in patches, shelterwood, or selection--most effectively converts old-growth redwood into younger managed stands. The results from these studies are expected to furnish timely guides for managing the estimated 20- to 30-year supply of old-growth timber still remaining in the redwood region.

Some of the questions to be investigated are:

. . . . How do different reproduction cutting methods and post-logging treatments affect natural regeneration of redwood?

. . . . How does the growth of reserve trees in shelterwood cuttings compare to growth of those left after selection cutting? Can the future growth of individual trees be predicted accurately?

. . . . How do utilization problems differ for selection, shelterwood, and patch clear cutting?

. . . . Can shelterwood and selection cutting areas be relogged without too much damage to reproduction and reserve trees?

. . . . Can soil movement and streamside disturbance be reduced to a minimum by careful road engineering and post-logging treatment of skidroads?

. . . . Can the dangerous fire hazard of slash concentration be eliminated without excess damage to reserve trees?

. . . . What type of management—even-aged, uneven-aged, or both—is silviculturally and economically feasible for redwood?

. . . . Are animal activities significant in establishing young-growth stands?

. . . . How do tractor logging costs vary with cutting methods?

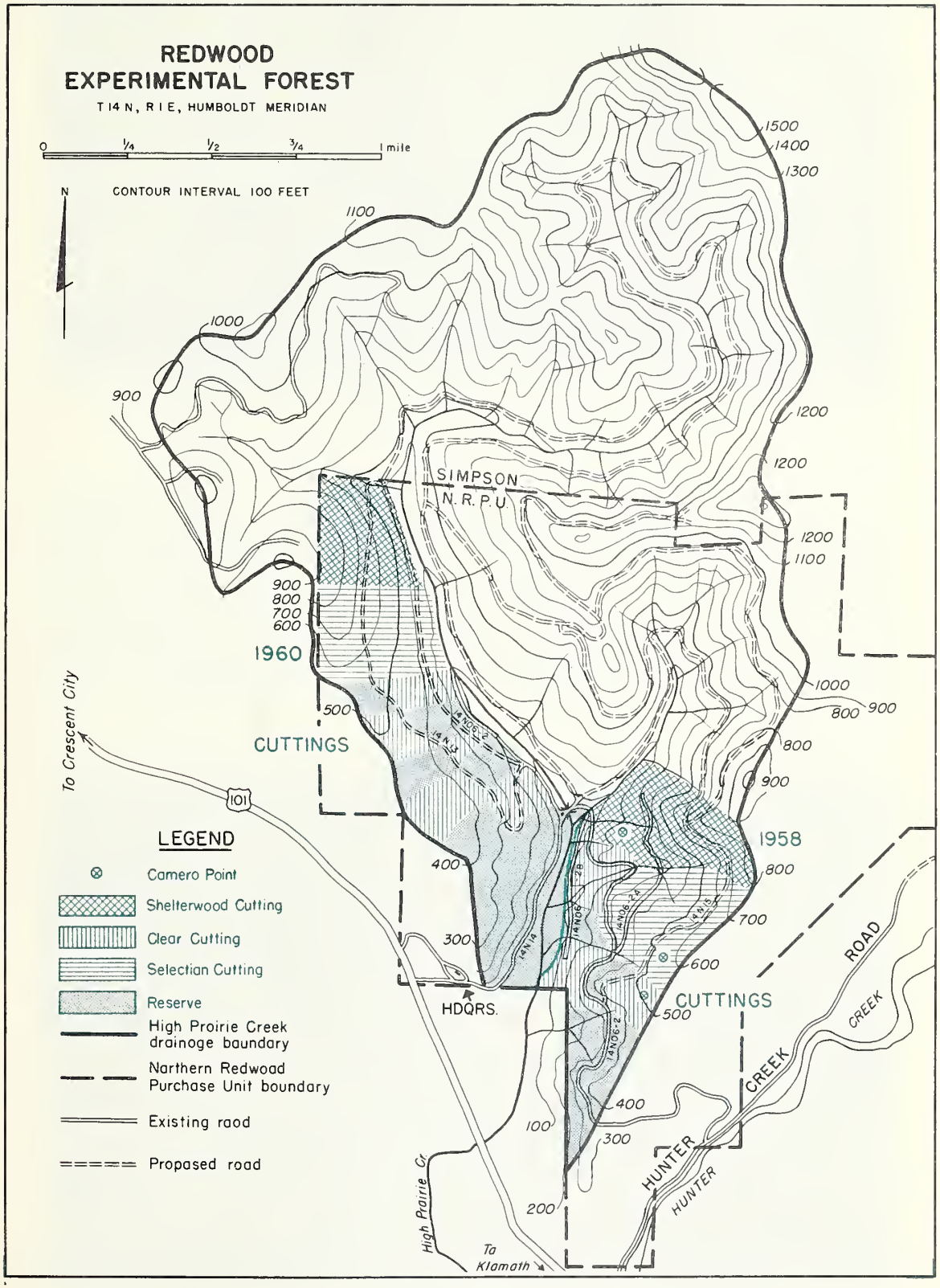

REDWOOD
EXPERIMENTAL FOREST
T 14 N, R 1 E, HUMBOLDT MERIDIAN
0 1/4 1/2 3/4 1 mile
N
CONTOUR INTERVAL 100 FEET
SIMPSON
N.R.P.U.
1960
CUTTINGS
1958
CUTTINGS
HDQRS.
ROAD
CREEK
HUNTER
HUNTER
CREEK
High Prairie Cr.
To Crescent City
101
To Klamath
LEGEND
Camera Point
Shelterwood Cutting
Clear Cutting
Selection Cutting
Reserve
High Prairie Creek drainage boundary
Northern Redwood Purchase Unit boundary
Existing road
Proposed road

Figure 1. --Timber stand before logging on first clear cutting.

THE CLEAR CUTTINGS range in size from 10 to 20 acres. On these units all merchantable trees, except a few healthy, vigorous trees under 100 years old, are harvested. The cuttings alternate with reserved patches of equal acreage. The reserved patches, which will provide seed for reproducing the cut-overs, will be cut in about 20 years. Even-aged stands will result from this method of cutting. Two or more age classes will eventually develop in a patchwise arrangement depending on the time elapsed before cutting the reserved blocks.

Figure 2. --Same area after logging.

Figure 3. --Before logging shelterwood cutting.

THE SHELTERWOOD CUTTINGS range in size from 50 to 70 acres. On these the first cut opens the main crown canopy at least 50 percent to encourage reproduction. On one half of each shelterwood tract, the remaining merchantable saw-timber will be cut after reproduction is satisfactorily established. On the other half, the remaining timber will be removed in two cuts: the first will take half the canopy and the second will remove the last part of the overstory 10 years later. Generally, vigorous trees of moderate and good quality will be reserved for seed production and additional growth during the reproduction period. All other merchantable trees will be cut. The resultant new stands will be even-aged.

Figure 4. --After felling on shelterwood unit.

Figure 5. --Before logging selection cutting.

SELECTION CUTTINGS also are 50 to 70 acres in size. They will be cut over on a 10-year cutting cycle with a tentative rotation of 100 years. In the first cutting, trees selected for felling were uniformly spaced and occupied about 10 percent of the total ground area. About one-half the volume was harvested in large trees which were low in vigor and medium to good in quality. Other miscellaneous smaller trees also were cut. Vigorous trees of all sizes and quality were reserved as growing stock. The intent is to produce and maintain an uneven-aged stand. This series of cuttings is the first true selection regeneration cutting method attempted in the redwood type.

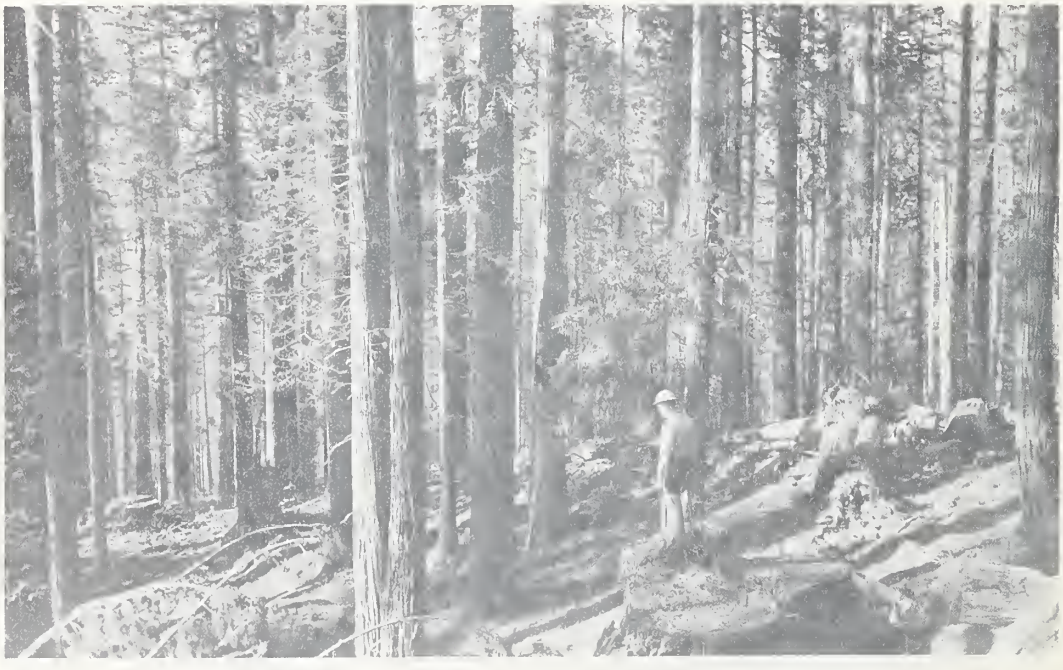


Figure 6. --After logging selection cutting.

First Results

Old-growth redwoods have some unusual characteristics not present in other timber types, at least to the same degree. These characteristics may limit the variety of stand treatment and influence the results. For example, the extreme age of old-growth redwoods exceeds the proposed rotation by 5 to 10 times. The main stand on the Experimental Forest is from 500 to 1,000 years old, and a 100-year rotation is planned. Hence a drastic change in age structure will be attempted on the selection cuttings in a relatively short time. What difficulties will be encountered in growing the young trees intermingled with a partial stand of old growth?

Other distinctive stand characteristics are the large size of the trees, the heavy volumes per acre, and the amount of defect. Many trees are 8 to 14 feet in diameter. Volumes per acre on the first clear cutting averaged 136,023 board feet by Humboldt scale, and 171,000 board feet (net) by Scribner. Defect in the logs hauled amounted to 12 percent. In Scribner volume an additional 35,000 to 40,000 board feet of cull logs and broken wood remained on the ground.

Figure 7. --Redwood log measures 124 inches small end and scales 14,900 board feet (Scribner).

Figure 8. --Logging residue on clear cutting.

The unutilized sound wood left per acre on the first clear cutting averaged 4,531 cubic feet (27,000 board feet). This material was contained in cull and small logs, and broken pieces from 2 feet to 40 feet long. Sound wood less than 8 feet long scaled 692 cubic feet; longer lengths, 3,839 cubic feet. If this residue could be marketed economically, some of it would be suitable for sawing into lumber and some would be suitable for split products. Nearly all of it could be chipped for pulp, particle boards, or other uses.

When more complete wood utilization becomes economical, the volume of slash will be reduced significantly. This development will have at least three benefits. It will put to human use a raw material now wasted. It will lower the cost of slash disposal—an operation necessary to reduce fire hazard and to provide space for the new seedling crop. And immediate removal of residual sound wood after prime logging will minimize future stand disturbance.

The effects of constructing layouts, the beds of earth into which the larger redwoods are felled to reduce breakage, need specific evaluation on all cuttings. Layouts are commonly prepared on uneven ground for the better quality trees over 6 feet in diameter. Because they prevent the loss of considerable valuable timber, layouts are an important practice necessary to approach full timber utilization. However, layout construction often results in extensive soil disturbance. This disturbance may not be critical in clear cutting although it may reduce site productivity for a time by covering top soil and exposing subsoil. In partial cuttings, however, layouts may have more drastic effects, particularly on uneven and steep slopes. Layout construction

sometimes undercuts the roots of reserve trees. These trees may be windthrown later or slide downhill when heavy rains saturate the soil. If layouts are used in subsequent partial cuts, damage to reproduction is likely. Hence the problems are, first, to learn more about the amounts and kinds of undesirable effects and, second, to explore the possibilities for modifying layout design and construction to minimize these effects.

Forest regeneration has started quickly in cutover stands. Some redwood stumps on the first clear cutting had begun to sprout before logging was completed in August. Seed from the surrounding reserved timber was falling in September soon after slash disposal. The seedbed was in excellent condition to receive the seed.

A few new seedlings, which probably germinated during unseasonal warm weather in December, were found on January 6. However, rapid germination in both the clear cutting and partial cuttings was not observed until the third week in March.

Figure 9. --Seed traps used to sample seed dispersal

Abundant sound seed was dispersed in the cutovers:

1. Selection cutting--4, 013, 000 per acre.
2. Shelterwood cutting--1, 408, 000 per acre.
3. Clear cutting
    a. Surrounding timber--2, 249, 000 per acre.
    b. 132 feet from edge--795, 000 per acre.
    c. 264 feet from edge--617, 000 per acre.
    d. 396 feet from edge--196, 000 per acre.

Germination tests are incomplete, but germination of the sound seed (real germination) appears to be greater than 70 percent.

Seedling survival studies have begun.

Small mammal populations on the first clear-cutting area were surveyed by Humboldt State College cooperators. Before cutting, shrews were the principal small mammals present. The post-logging survey indicated mice were most abundant. This population change may influence the success of natural regeneration because mice are voracious seed-eaters.

Windthrow loss was sustained during a severe storm in the first winter after logging. The heaviest blowdown was found in a reserve block where an edge paralleling the crest of a spur ridge had been exposed by clear cutting the adjacent unit. About 15 percent of the redwood trees of all sizes were windthrown.

Another reserve block nearby was located lower on the slope and was somewhat protected from the winds. Here only a few suppressed hemlock were blown down.

Some trees also were windthrown in the partial cuttings. Losses were greater in the selection than in the shelterwood area. Tree classes most frequently blown down were the smaller codominant and intermediate redwoods, and other species in the lower crown canopy.

Soil erosion was observed and sampled before logging began. Considerable sediment observed in High Prairie Creek during high stream flows was traced to natural bank sloughing and channel cutting. To evaluate the amount of erosion attributable to road building and logging, stream sampling is being continued.

Soil-vegetation information from a recent survey of the entire watershed is used in planning studies and reporting results and will be useful for extending experimental results to other areas. Soils occurring in the area are commonly associated with redwood and Douglas-fir stands and are derived from Franciscan sedimentary rocks. The soil series are:

Melbourne--on about 76 percent of the area. Is deep, permeable, well drained, moderately to strongly acid, moderately fine textured, and dark brown. Has a well developed profile (immature).

Hugo--on about 15 percent of the area. Is a gray-brown Podzolic residual soil developed from sandstone and shale. Is deep, permeable, well drained, moderately acid, medium textured, and grayish brown. Has a slightly developed stony profile (young).

Josephine--on about 4 percent of the area. Is a gray-brown Podzolic residual soil developed from highly weathered sandstone. Is deep, permeable, well drained, strongly acid, moderately fine textured, and reddish brown to reddish yellow. Has a well developed profile (immature).

Atwell--was mapped in a few small spots, aggregating about 1 percent of the area. Although limited in extent, this series is important in engineering because it has a marked tendency to slide, and roads built on Atwell soil are extremely difficult to maintain.

Alluvial--covers about 4 percent of the watershed. Is limited to the lower reaches of the main stream.

Figure 10. --Clay loam soil, deep, permeable, well drained.

The Future

Some of the preliminary results stimulate speculation concerning the outcome of this research program. Can all-aged young forests be grown successfully by forcing a great age structure change through selection cutting of old-growth? On all partial cuttings the logging disturbance and injury to reserved trees during the initial cuts generally is severe. How will the future growth of these trees be affected? What will happen to the young growth when we re-log the partial cuttings? Intensive utilization is probably more of a problem here than in other timber types. How can we improve this part of our logging operations? Reproduction is starting quickly, but will establishment be successful?

List of Tree Species

	Common name	Scientific name
1.	Douglas-fir	Pseudotsuga menziesii (Mirb.) Franco
2.	Port-Orford-cedar	Chamaecyparis lawsoniana (A. Murr.) Parl.
3.	Redwood	Sequoia sempervirens (D. Don) Endl.
4.	Sitka spruce	Picea sitchensis (Bong.) Carr.
5.	Western hemlock	Tsuga heterophylla (Raf.) Sarg.
6.	Western redcedar	Thuja plicata Donn

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